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THE ANATOMICAL RECORD, VOL. 23, NO. 2,
FEBRUARY, 1922.

Resumen por los autores, Alden B. Dawson y J. H. Reis.

Una irrigación arterial anómala en la suprarrenal, riñón y ovario.

En el presente trabajo se discuten arterias anómalas halladas en un feto humano a término. En la arteria renal derecha 'normal,' que penetra en el riñón a través del hilus, nace una arteria renal accesoria, la cual después de enviar dos ramas suprarrenales pasa sobre la superficie antero-superior del riñón enviando ocho ramas a su tejido, terminando finalmente en la glándula suprarrenal. La primera rama suprarrenal se reune con un plexo arterial, del cual nacen cuatro delgadas ramas suprarrenales. De este plexo parten también ramas que terminan en la musculatura dorsal. El tronco renal izquierdo está dividido en tres ramas. La rama inferior penetra en el riñón a través del hilus. Las ramas media y superior, las arterias renales accesorias, se distribuyen sobre el polo superior. La rama renal media envía una rama accesoria a la glándula suprarrenal. La renal superior envía dos ramas a la suprarrenal (arterias suprarrenales media e inferior), y dos ramas a la musculatura dorsal. La arteria ovárica derecha se origina dentro del riñón, estando formada por la unión de varias ramas de las arterias renales interlobares y, después de emerger a través del polo inferior del riñón, sigue un trayecto normal. Estas anomalías son interpretadas por los autores como una prueba en favor de la opinión de Bremer, quien supone la existencia de un plexo periaórtico temprano del cual derivan las arterias renal, suprarrenal y la que se distribuye sobre la glándula sexual.

Translation by José F. Nonidez
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AN ANOMALOUS ARTERIAL SUPPLY TO SUPRARENAL, KIDNEY AND OVARY

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TWO FIGURES

Anomalous blood vessels are always interesting from a purely scientific point of view, especially since they so often shed light on obscure problems of phylogeny and ontogeny. They may also be of considerable significance from a clinical or surgical standpoint.

Variations of the suprarenal and renal arteries occur very frequently, and anomalies of the ovarian or internal spermatic arteries are not uncommon. The cause of the extreme variability of these blood vessels is found in their embryonic history, and since they are derived from a common source (Broman, '06, '07; Bremer, '15), all combinations of the several vessels are to be expected. The anomalies in the specimen described in this paper illustrate rather nicely some phases of arterial development as outlined by Bremer ('15) in his discussion of the origin of the renal artery in mammals.

DESCRIPTION

The subject of the present description was a well-proportioned, full-term human fetus (female). The anomalies noted were discovered during the regular dissection in the course in infant and fetal anatomy and the body was put aside for further study. Apart from the variations to be discussed in detail here, the specimen exhibited several other important arterial anomalies. There was no right innominate artery. The right subclavian artery arose as the last branch from the left extremity of the arch of the aorta and passed obliquely toward the right side,

behind the trachea, oesophagus and right carotid. The two common carotids were united into a very short single trunk. In addition to this, the right umbilical artery was absent. This last anomaly is important, since a single umbilical artery is usually associated with fusion of the lower limbs (sympodia), and it will be described elsewhere.

The inferior phrenic arteries arose from the coeliac axis. They appeared relatively large and each gave off several small branches (superior suprarenal) to the suprarenal gland of its own side. (The course of the arteries is not shown in figure 1, as the glands are pulled upward to show other details of the circulation.) The right middle suprarenal was comparatively small. In the fetus it usually approximates the renal artery in size. It arose directly from the aorta. The left middle suprarenal artery arose from an accessory renal artery.

The arterial supply to the right kidney arose from the aorta as a single trunk, but soon divided into two vessels of almost equal size. The superior division (an accessory renal artery) gave off almost immediately a small suprarenal branch, which has been designated the inferior suprarenal, although other suprarenal branches arose from this same division of the renal trunk. After giving off the inferior suprarenal branch, the accessory renal artery ran but a short distance when it was divided into two branches, forming a superior and an inferior division. The superior branch ran upward to the suprarenal gland by way of an arterial plexus and terminated in four slender branches. The arterial plexus with which it communicated sent branches also into the dorsal musculature, the right psoas major muscle and the right crus of the diaphragm. The inferior branch of the accessory renal artery also terminated in the suprarenal gland, but it passed over the anterior superior surface of the kidney and sent at least eight branches into the renal tissue. The inferior division of the main renal trunk, the normal renal artery, entered the kidney at the hilus.

The arterial supply to the left kidney also arose from the aorta as a single trunk. It soon divided, however, into three main branches, a superior, a middle, and an inferior. The

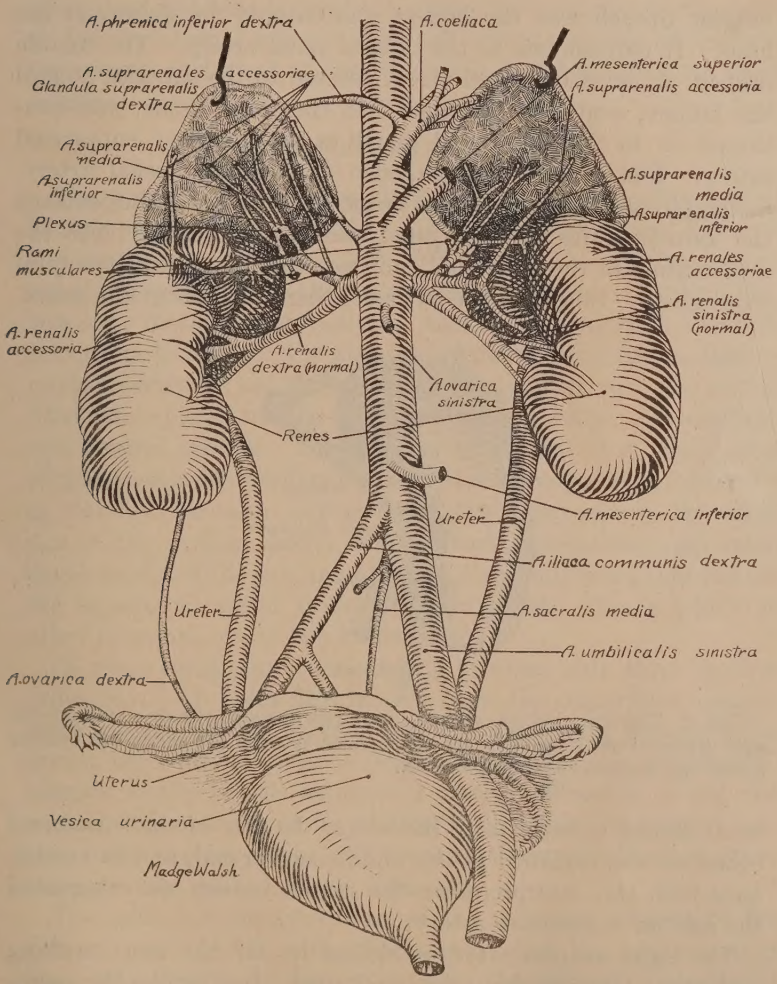

Fig. 1 Semidiagrammatic drawing of the abdominal aorta and its main branches (viewed from in front), showing the anomalous arterial supply to the suprarenal glands, kidneys, and right ovary. The suprarenal glands are pulled upward off the superior poles of the kidneys. Note the single umbilical artery (left) and the lateral displacement (to the right) of the uterus and urinary bladder.

inferior branch was the largest and entered the kidney at the hilus. It corresponds to the normal renal artery. The middle branch, an accessory renal artery, passed to the superior pole of the kidney, sent two branches into the renal tissue, and continued on to the suprarenal gland as an accessory suprarenal artery. The superior branch, also an accessory renal artery, divided irregularly into several branches. Two branches entered the kidney at its superior pole; two passed dorsally into the musculature of the body wall and two others supplied the suprarenal gland. Since, on the left side, there was no middle supra-

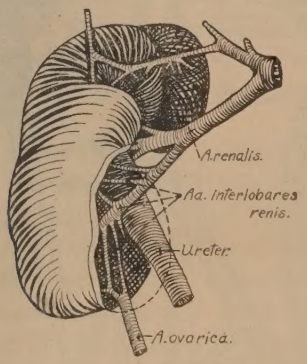

Fig. 2 The right kidney, ventral view, with the medial half of the inferior pole dissected away, to show the connections between the anomalous ovarian artery and the interlobar renal arteries.

renal arising directly from the aorta, the first of the suprarenal branches was regarded as the middle suprarenal, and in accordance with this interpretation the second branch was designated the inferior suprarenal artery.

The right ovarian artery exhibited by far the most striking variation. It arose from the renal artery, but, unlike the variations previously described in which the ovarian arteries were given off before the kidney was reached, the artery in this case was given off within the kidney, being formed by the union of three branches from the interlobar renal arteries (fig. 2). It emerged from the inferior pole of the kidney (fig. 1), and its

course and relations beyond the kidney were practically the same as for the normal artery. The left ovarian artery arose from the ventral surface of the aorta a short distance below the renal arteries.

EMBRYOLOGICAL SIGNIFICANCE

There is not complete unanimity regarding the embryological history of the arterial supply to the suprarenal glands, kidneys, and sex glands. Broman ('06, '07) derives the arteries supplying these organs from the mesonephric arteries. Bremer ('05), however, disagrees, partially at least, with Broman's account. According to Bremer, the arteries are developed from 'an anastomosing periaortic net having many connections with the aorta.' This net or plexus usually unites dorsal segmental, mesonephric, and ventral arteries. Bremer also points out that the history of this development differs in different mammals, being influenced in man by the lesser curvature of the rump region, the small size of the wolffian body, and the early appearance and rapid development of the suprarenal gland, the result being that in man the suprarenal gland primarily receives the vessels which in other mammals go to the kidney.

Of these numerous anastomosing arteries, only three survive ordinarily. An ascending branch from the uppermost usually becomes the inferior phrenic artery, a descending branch of the lowest becomes the normal renal artery, while the middle one persists as the middle suprarenal artery. Whether or not the normal channels are to be utilized is probably determined mechanically to some extent. If the normal course is blocked, other more devious paths may be followed.

The relations, described here of the accessory arteries to the kidneys and to the suprarenal glands, and the anastomosing connection within the kidney between the normal renal arterial supply and the ovarian artery, support Bremer's claim of an early periaortic net.

Additional evidence in favor of this view is found in three cases (IV, VI, and IX) of anomalous renal arteries described by Gillaspie, Miller, and Baskin ('16). In case IV, a left acces-

sory renal artery was given off from the superior mesenteric artery. In case VI, one of the four large-sized renal arteries supplying the right kidney arose from the coeliac axis. These cases indicate an early connection between the lateral and ventral aortic branches.

In case IX the main renal trunk on the right side was connected with the aorta by a plexus of vessels of varying sizes, and on the left side two small arteries came from a plexus which resembled the periaortic plexus. The varying arterial plexi noted can be regarded as examples of local persistence of the early anastomosing periaortic net. That these connections must be 'early' and not 'late' or secondary is shown by Bremer, since they can only be formed from vessels present in the embryo before the aorta and its larger branches develop mesodermal coats (10- to 12-mm. embryos). Towards the close of his paper Bremer ('15) states: "Dorsal connections of the suprarenal arteries with the body wall or with the true dorsal segmented arteries can be conjectured as a persistence or extension of the plexus." His conjecture is realized in the fetal circulation described, since part of the abnormal suprarenal supply was linked with a plexus which sent branches into the dorsal body wall.

SUMMARY

Anomalous arteries, found in a full-term human fetus, are discussed in this paper. Arising from the 'normal,' right, renal artery which entered the kidney at its hilus, there was an accessory renal artery, which, after giving off two suprarenal branches, passed over the anterior superior surface of the kidney, sent eight branches into its tissue, and terminated finally in the suprarenal gland. The first suprarenal branch was regarded as the inferior suprarenal artery. The second branch joined an arterial plexus, from which four slender suprarenal branches arose. From this plexus branches were also given off to the dorsal musculature.

The left renal trunk was divided into three branches. The inferior branch entered the kidney at the hilus. The middle and superior branches, accessory renal arteries, supplied the superior pole. The middle renal branch sent an accessory branch to

the suprarenal gland. The superior renal branch sent two branches to the suprarenal gland (middle and inferior suprarenal arteries), and two branches into the dorsal musculature.

The right ovarian artery arose within the kidney, being formed by the union of several branches from the interlobar renal arteries, and after emerging from the inferior pole of the kidney pursued a normal course.

These anomalies are interpreted as supporting Bremer's claim of an early periaortic plexus from which the renal, suprarenal, and sex-gland arteries are derived.

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Resumen por el autor, W. E. Sullivan.

La anatomía de una mano sindáctila.

La mano estudiada presenta una unión completa de los dedos mediante membranas y una fusión parcial de los elementos óseos. Los carpianos están reducidos a seis, los metacarpianos a cuatro y las falanges a siete. Los músculos más modificados son los flexores largos; los lumbricales, que faltan; los interóseos, de los cuales hay solamente uno. Las inserciones de los flexores largos han emigrado proximalmente hasta transformarse en flexores de la muñeca. Las modificaciones musculares y óseas están relacionadas parcial, no completamente. Elementos fibrosos tienden a sustituir a los elementos óseos ausentes. La condición vascular, aunque no es la ordinaria, pudiera presentarse en una mano normal. La distribución de los nervios está relacionada directamente con otras modificaciones. La extirpación de los dos dedos intermedios aumentaría la utilidad de la mano.

Translation by José F. Nonidez
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THE ANATOMY OF A SYNDACTYLOUS HAND

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ONE FIGURE

The hand in question may be referred to as brachydactylous as well as syndactylous, for there is a reduction of one phalanx in each digit in addition to the webbing and fusion. It is the right hand of a male laborer about forty years old. The left hand is normal. Nothing is known of the family history.

The general shape of the hand is sufficiently indicated by the radiograph. The volar surface is unbroken and there is no indication of separate digits. The thenar and hypothenar eminences are well marked. The thenar eminence is slightly reduced, but the hypothenar would equal the average normal elevation. The skin is thick, creased, and calloused and indicates a serviceable hand.

On the dorsal surface the presence of separate digits is suggested by three well-defined nails. These three nails are fairly indicative of the internal condition. The x-ray shows part of a fourth digit and suggests that there are five terminal phalanges. Dissection shows more clearly that there are five terminal phalanges.

In the discussion it seems best to refer to the digits as the radial, radial intermediate, ulnar intermediate, and ulnar in the order indicated. From the relations found on dissection it was interpreted that the radial digit represents the first and second digits, the radial intermediate, the ulnar intermediate, and the ulnar represent the third, fourth, and fifth digits, respectively.

MODIFICATION OF THE BONES

The bones of the forearm show little if any modification. The distal end of the radius is slightly enlarged.

Six carpal elements are present. These are interpreted as representing the ossa naviculare and lunatum in the proximal row, the multangulum majus, capitatum, pisiforme, and triquetrohamatum in the distal row. The position and articulations of the several bones are seen in the radiograph. It may be pointed out that the distal end of the navicular overlaps the volar surface of the greater multangular. The os multangulum minus is absent. The os capitatum is greatly modified and corresponds to the proximal portion of the normal bone. The condition of the last two bones is in line with the general modification of the second and third digits. The os pisiforme is much flattened and somewhat larger than is usual. The os triquetrohamatum is the name given to the large medial bone of the distal row. Its position and articulations as well as its size and shape indicate that it is the result of the fusion of the triquetrum and hamatum. The hamulus is much reduced.

The metacarpals show a considerable range of modification. The radial metacarpal is normal at its proximal end, but at the distal end presents two large articular surfaces, somewhat separated by a ridge, for the phalanges, and a small volar facet for a sesamoid.

The metacarpal of the radial intermediate digit is represented proximally by a small, ovoid, bony element. This bony element is imbedded in a wedge of fibrous tissue which has its base against the capitate and which, at its distal end, is connected with the phalanx by a round ligament more than a millimeter in diameter.

The two medial metacarpals are fused at their proximal ends. At the distal end each presents an articular surface for its phalanx.

In addition to the loss of one phalanx in each digit, there are one or two interesting modifications. The radial phalanx is large and irregular and is formed by the fusion of two terminal phalanges. The proximal end has two distinct articular surfaces, well separated by a groove. The more medial lies some-

what dorsad. On the dorsal surface the individuality of the two phalanges is clearly seen. The fact that the radial digit is equal in length to the other digits naturally suggests that there has been a fusion of the proximal and distal phalanges rather than the loss of a phalanx. There is nothing in the structure of the phalanx to indicate that this has been the case.

The proximal phalanx of the radial intermediate digit represents only the distal end of a phalanx, but, as already pointed out, it is joined to the metacarpal by a heavy ligament. The proximal phalanx of the ulnar intermediate digit is fused with its metacarpal and is somewhat longer than the other phalanges.

MODIFICATION OF THE MUSCLES

The forearm is well developed and at the elbow is but slightly smaller than its fellow. The muscles inserting on the radius and ulna are not modified. Those having a more distal insertion may be best discussed individually.

The palmaris longus, palmaris brevis, and flexor carpi ulnaris are normal.

The thenar muscles as a group are fairly well developed and arise from the lateral half of the transverse carpal ligament. The deeper fibers insert into the metacarpal. The more superficial fibers separate into two bundles to insert in part mediad and in part laterad on the volar surface of the base of the phalanx. The innervation suggests the absence of the adductor pollicis.

The hypothenar muscles are better developed than the thenar group. They arise from the pisiforme and medial half of the transverse carpal ligament and insert into the metacarpal and proximal phalanx. All of the hypothenar muscles are present.

But one interosseous muscle is present. It is a poorly developed volar interosseous of the ulnar digit.

The flexor digitorum sublimis is relatively small and ends in two small tendons which insert into the capitate and hamate. In addition, the tendons of the sublimis and profundus converge to form a common tendon of insertion into the distal row of carpals and the bases of the metacarpals. It acts only as a flexor of the wrist-joint.

The flexor digitorum profundus is of normal size. It goes over for the most part into the common tendon with the sublimis, but sends one tendon to the proximal phalanx of the ulnar digit. This tendon gives flexion and adduction at the metacarpophalangeal joint. The muscle as a whole acts as a flexor of the wrist-joint.

The lumbricals are absent.

The flexor carpi radialis inserts into the radial metacarpal.

The extensor carpi radialis longus inserts on the dorsum of the base of the radial metacarpal. The extensor carpi radialis brevis is absent.

The extensor digitorum communis has two tendons of insertion. The lateral tendon inserts on the phalanx of the radial digit. The medial tendon lies in the plane of the ulnar intermediate digit and for the most part inserts into the metacarpal. In addition it sends a slip to the radial intermediate metacarpal and a larger slip which attaches rather loosely to the dorsum of the ulnar metacarpal.

The abductor pollicis longus inserts into the lateral surface of the base of the radial metacarpal. Just dorsal to this is the insertion of the extensor pollicis brevis.

The extensor pollicis longus has an origin corresponding to the combined origin of itself and the extensor indicis proprius. It inserts into the terminal phalanx of the radial digit well toward the lateral margin.

The extensor digiti quinti proprius inserts into the proximal phalanx of the ulnar digit.

VARIATIONS IN THE ARTERIES

The ulnar and interossei vessels supply the forearm and hand. The radial artery is absent, while the volar interosseous is much enlarged. Such a condition might occur in an otherwise normal hand, and it is perhaps unwise to correlate it with the other factors.

There is but one volar arch which is formed largely by the ulnar, but which is completed by a perforating branch from the volar interosseous. The terminal branches of the volar interosseous supply the dorsum of the wrist and hand.

NERVES

The cutaneous distribution of the nerves showed nothing beyond the usual range of variation. On the dorsum of the hand they may be traced farther distally on the terminal phalanx than is usually possible on a normal hand.

MOVEMENTS AT THE SEVERAL JOINTS

The radiocarpal and carpometacarpal are biaxial joints. The movements in the former are normal. In the latter flexion and extension are possible through a range of about 80°, but abduction and adduction are modified in several ways. The fusion of the bones in the two medial digits as well as the general webbing restrict the movements. Splitting the hand and removing all of the ulnar intermediate digit except the base of the metacarpal added greatly to the range of forced movement.

SUMMARY

Muscular and osseous modifications are partially but not completely correlated. Fibrous elements tend to take the place of absent bony elements.

The vascular condition, while unusual, might occur in a normal hand.

The distribution of the nerves is directly correlated with the modification of the other structures.

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PLATE 1

EXPLANATION OF FIGURE

Radiograph of a right hand. In the text the digits are referred to as radial, radial intermediate, ulnar intermediate, and ulnar.

Resumen por el autor, Warren H. Lewis.

¿Es el mesenquima un sincicio?

Una revisión de la literatura referente al mesenquima considerado como un sincicio no ha revelado una sola prueba sobre la fusión de los procesos celulares, produciendo continuidad citoplásmica. En material fijado es imposible decidir si se trata de una adhesión o de una fusión. Los crecimientos del mesenquima embrionario en cultivos de tejidos procedentes de embriones de pollo forman un retículo semejante al que se observa en el embrión. Puede seguirse la lenta emigración de las células, la retracción de los procesos de las células vecinas y la producción de nuevos procesos en la misma o en otras células. Las células con muchos procesos pueden aislarse completamente de todas las demás células del retículo y, sin embargo, no se comportan de un modo diferente del de las células que forman aquel. Los procesos adheridos al cubre objectos se comportan lo mismo que los que se insertan en células vecinas, con la excepción de que los primeros se adhieren más firmemente. No existe prueba alguna sobre la transferencia de material alguno desde unas células a otras. Si se añaden soluciones hipertónicas a los cultivos, las células se transforman en redondas, perdiendo toda conexión con las células vecinas. En un tipo de degeneración se produce un efecto algo semejante. Las células hijas no permanecen fusionadas de un modo permanente sino que finalmente se encuentran en la misma relación que las demás células del retículo, o hasta pueden perder toda conexión. Las pruebas obtenidas mediante el estudio de los cultivos indica que el mesenquima embrionario es un retículo adherente y no un sincicio.

Translation by José F. Nonidez
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IS MESENCHYME A SYNCYTIUM?

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FOUR FIGURES

Many anatomists consider the mesenchyme a syncytium. They believe there is actual fusion of process with process, continuity of the cytoplasm, and absence of cell boundaries. In ordinary preparations of embryonic and adult material such fusion of cell processes appears to exist; but is this sufficient evidence upon which to base a distinction between actual fusion and mere adhesion? If one stops to consider the extreme delicacy of such processes in the embryonic mesenchyme, one must admit that here, at least, the methods used have not been adequate to settle the question. In fixed material it is simply impossible to tell whether there is fusion or adhesion. A review of the literature dealing with mesenchyme as a syncytium has not disclosed to me one single instance of actual proof that mesenchyme really is syncytial in nature. It is a question which cannot be solved by the methods now employed. The idea that mesenchyme cells are fused together dates back at least as far as the time of Max Schultze ('61),[1] and from that time to the present this view seems to have prevailed among the majority of investigators who have studied the origin and development of the connective tissues. No special effort has been made in the past to prove this particular point, for the reason, I suppose, that ordinary sections appeared to show clearly that the cells were fused, and so it seemed too much a matter of fact to call for a special investigation.

In the early days of tissue culture we used the term 'syncytium,' adopting the prevailing view of the nature of this tissue,

[1] Schultze, Max. 1861 Ueber Muskelkörperchen und das, was man eine Zelle zu nennen habe. Archiv. f. Anat. und Physiol. Reichert.

since the outgrowths resemble in general character the tissue as it exists in the embryo. From the behavior of such cells in tissue cultures, however, I have gradually come to doubt the correctness of the view that the mesenchyme is syncytial in nature, and it is my purpose here to present briefly the evidence.

The cultures utilized in the study were all from embryonic chick material of various organs and regions, for the most part from the subcutaneous tissue. They were made in the usual manner with fluid media consisting of Locke's solution 80 parts, dextrose 0.25 to 0.5 per cent, and chicken bouillon 20 parts.

The general appearance of the mesenchymal reticulum in the more normal cultures is strikingly similar to that in the embryo, and there is no reason to believe that the nature of the attachment of one cell to another is different in the cultures from that in the embryo.

The first cells that migrate out often become entirely isolated from the explant and from one another, but as the number increases they crowd together, and a complicated reticulum, similar to that in the explant, is formed in the outgrowth. Thus it would seem that the early migrating cells have no difficulty in becoming entirely isolated from the reticular network in the explant of which they were a part, by forces which pull or force them out.

It has been assumed by many that the mesenchymal syncytium was brought about in part, at least, by the failure of the cytoplasm to divide completely after division of the nucleus. We have often observed a lingering connection between daughter cells for an hour or more after division. Many daughter cells, however, ultimately move some distance apart and the character of their attachment is then no different from that between these and neighboring cells.

In living cultures in fluid media the outgrowths of mesenchyme, as well as of most other types of cells, tend to be forced by the conditions of the environment into a single plane lying between the cover-glass and the fluid. The cell bodies, of course, project down into the fluid, but this becomes less and less marked as the cells flatten out more and more towards the

periphery of the outgrowth. Near the explant the cells are often more than one layer thick and their behavior, therefore, cannot be successfully observed; but the conditions at and near the periphery, or even in the middle of the outgrowth, afford an unusual opportunity for examining the relationship between the processes of one cell and the processes and bodies of neighboring cells (figs. 1 and 2). At the periphery the cells not only are more flattened, but usually become more widely separated and even entirely isolated from neighboring cells. In this region one can watch the slow shifting of cells from one position to another and can follow the withdrawal of processes which were adherent or in contact with the processes or bodies of neighboring cells. There is no reason to believe that such processes were previously fused with the processes or bodies of the neighboring cells, even though it is usually impossible to determine this by observation. In the slow withdrawal of the processes there is usually no evidence of a rupture. Many of the processes end on the cover-glass; except for the fact that they are more firmly adherent, there is apparently no difference in character between these processes and those attached to neighboring cells, and their withdrawal or change of shape proceeds in a similar manner. Simultaneously to the withdrawal of processes from neighboring cells or from the cover-glass, new processes are sent out along the cover-glass to the same cells or other cells and to other positions on the cover-glass. As cells become separated more and more at the periphery they may lose all connection with neighboring cells, their processes extending out and ending on the cover-glass. Such cells behave no differently from those forming part of the reticulum. This shifting of the relative positions of cells and of the area of attachment of their processes, and the changes in the size and shape of these areas of attachment, all indicate adhesion rather than fusion.

It is not uncommon, in cultures that have just been washed with a new solution of one kind or another, to find that the mesenchyme cells are drawing in their processes and losing connection with the neighboring cells and with the cover-glass. Such contraction may proceed until all connections with neigh-

boring cells are lost; it may even be so extreme that the cells lose their adhesion to the cover-glass, when the rounded cells may fall from the under-surface of the cover-glass to the lower surface of the drop. If, however, the cells retain their attachment to the cover-glass, they may later send out new processes onto the cover-glass, some of which may find their way to neighboring cells and their processes, and a reticulum is again established. Sometimes contraction is so violent that here and there processes are broken, the peripheral end remaining attached to a neighboring cell or the cover-glass, the proximal part withdrawing into the cell. Sometimes the mere transfer of the slide from the incubator to the warm observation box is sufficient to produce withdrawal of processes and more or less rounding up of the cells.

Hogue ('19)[2] found that when cultures of mesenchyme cells were treated with hypertonic Locke-Lewis solution, many of them withdrew their processes, became irregularly rounded, and lost connection with other cells, since all processes disappeared. Mrs. Lewis ('20)[3] found that in cultures of smooth muscle a minute amount of glycerin introduced into the neighborhood of the growth caused all cell processes to be immediately withdrawn, so that the cells became isolated individuals and remained so for several hours after the abnormal environment had been removed.

We should hardly expect cells to behave in this manner if they were actually fused together, though of course one cannot deny the possibility that they might do so, even under that condition. The mode of withdrawal of the processes in the rounding up of cells, however, indicates adhesion. When processes withdraw into the cell body, the line of separation does not come in the intermediate area between the bodies, but the processes seem to slip off from each other or from the cell bodies, just as they do when they are withdrawn under more normal conditions.

[2] Hogue, M. J. 1919 The effect of hypotonic and hypertonic solutions on fibroblasts of the embryonic chick heart in vitro. J. Exper. Med., vol. 30.

[3] Lewis, M. R. 1920 Muscular contraction in tissue cultures. Contributions to Embryology, vol. 9. Carnegie Inst. Wash., Pub. 272.

In one type of degeneration the processes are gradually withdrawn into the bodies of the cells and connections with neighboring cells disappear one after another until finally all connections are lost and many of the cells become entirely isolated from their neighbors. At the same time most of the processes which are attached to the cover-glass only contract into the body of the cell, and the latter assumes a more or less compact rounded shape (fig. 4). Such rounded cells may remain alive for some time and, if degeneration has not proceeded too far, a renewal of the medium may be followed by the sending out of new processes onto the cover-glass and to neighboring cells.

In fixed cultures, as in sectioned material, the network of processes in most places is so complicated that one cannot determine in the majority of cases whether the anastomoses are accompanied by fusion or by mere adhesion (figs. 1 and 2). Near the periphery, however, it is often possible to follow the outline of some very thin processes onto neighboring cells or processes of those cells, and it is not unusual for larger and longer processes to be followed over several neighboring cells (figs. 1 and 2). One cannot tell, of course, whether there is any fusion where such processes lie flat against other processes or cells in this fixed material, but the fact that under favorable conditions they appear to retain their individuality and their outlines can often be followed, in part or in their entirety, on neighboring cells, speaks against fusion. The difficulty in determining in all cases whether we are dealing with adhesion or fusion can readily be understood when we picture the conditions involved were an isolated cell such as that shown in figure 3 to be placed in such a complex network or reticulum as that shown in figure 1.

One interesting thing about the mesenchyme cells is the fact that they form in cultures a reticulum very similar to that in the embryo. Why do they behave thus and what are the factors that determine it? Why does the mesenchyme form a reticulum and the epithelium or endoderm a sheet or membrane? In the first place, we may safely conclude that the surface of the cells is sticky for each other and for the cover-glass, and that the physical factors of cohesion and surface tension or capillary attraction are constantly at work in altering the form

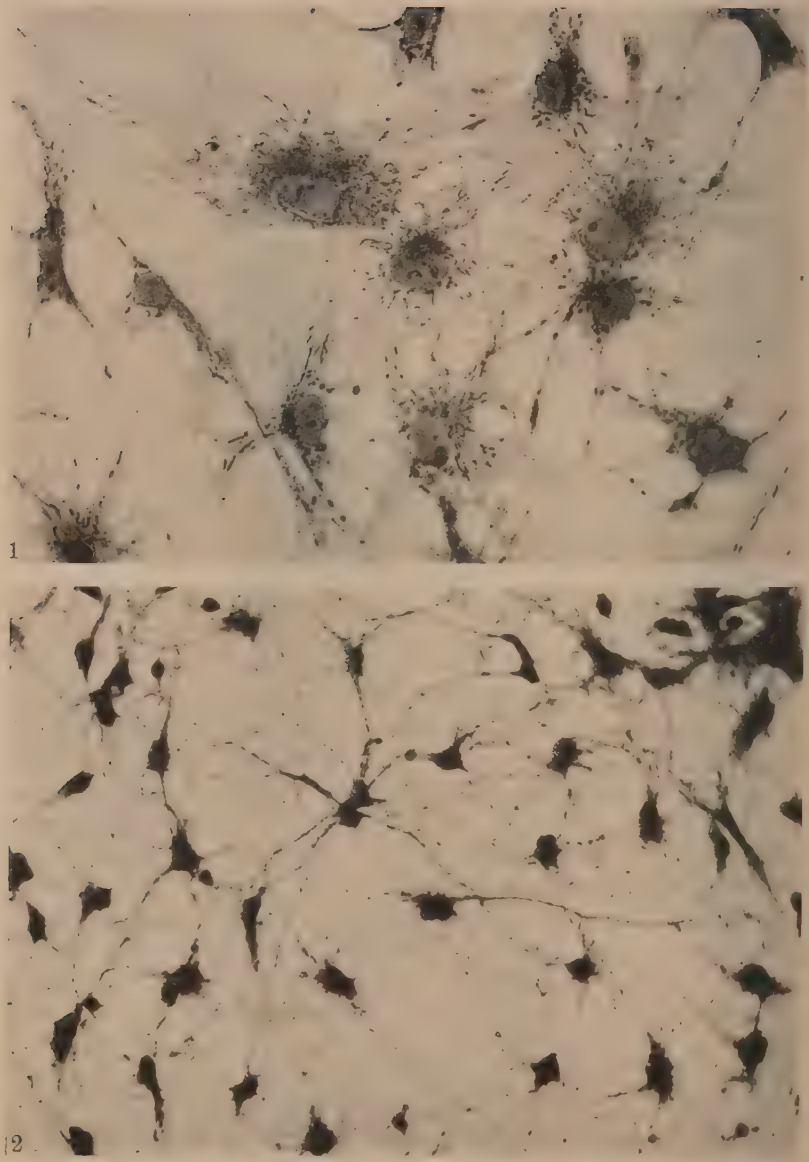

Fig. 1 Mesenchymal reticulum or network from the middle portion of the outgrowth of subcutaneous tissue from an eight-day chick embryo; two-day culture in Locke-Lewis solution; janus green, iodine. × 480

Fig. 2 Mesenchymal reticulum of subcutaneous tissue from an eight-day chick embryo; four-day culture in Locke-Lewis solution; janus green, iodine. × 480.

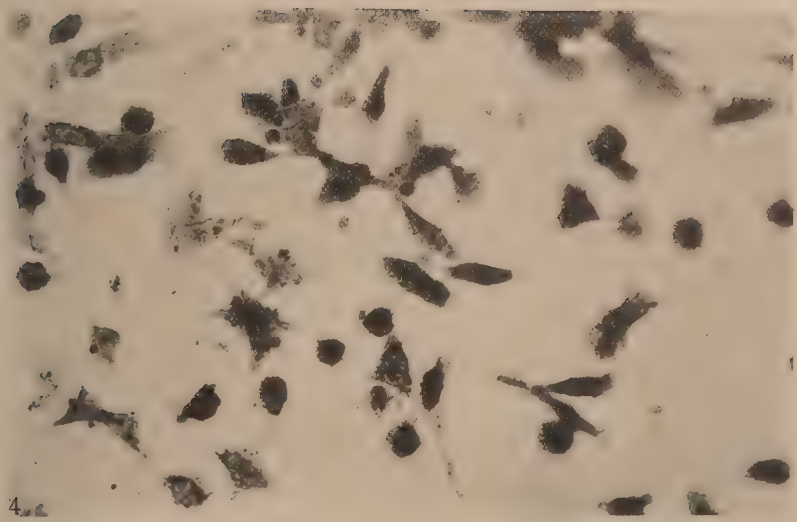

Fig. 3 Isolated mesenchymal cell near the edge of the outgrowth from the same culture shown in figure 1. × 1450.

Fig. 4 Contracting mesenchymal cells in a degenerating culture from the subcutaneous tissue of an eight-day chick embryo; four-day culture in Locke-Lewis solution; janus green, iodine. × 480.

and position of the cells and their processes. Evidently, the cohesiveness of the cytoplasm is constantly undergoing alteration in various parts of the cell and is probably initiated by local variations in the metabolism which produce local changes in fluidity and in surface tension (Loeb, '20).[4] The surface tension pull of the fluid medium bathing the cells is a constant factor and acts on the changing cells to produce shifting and variation in their protoplasmic processes. If we adopt such a tentative explanation for the mesenchyme cells and attempt to explain in a similar manner the smoother edges of the ectodermal and endodermal cells, it is obvious that we must assume that the cytoplasm of the latter is not subject to such extreme local variations in cohesiveness and surface tension. We know so little about the metabolism and the physical and chemical properties of the mesenchyme that it scarcely makes any difference whether we regard the mesenchyme as a syncytium or as an adherent reticulum. Yet the fact that such cells, both in cultures and in the normal embryo, retain their individuality, no two of them being exactly alike in size and shape, in number, or arrangement of their processes, in number, size, or arrangement of the mitochondria, in number, size, or position of the granules and vacuoles, or in the size and position of the nucleus and nucleolus, speaks for adhesion and for the independence of each cell. There is no indication of the transfer of material from one cell to another. We did believe at one time that mitochondria passed from one cell to another, but more critical examination of living cultures has convinced me that this is not true.

The development of the collogenic fibers, whether their origin be intercellular or intracellular, can be explained as readily from an adherent reticulum as from a syncytium.

CONCLUSION

There is no evidence that embryonic mesenchyme is syncytial in structure. The evidence from tissue cultures points to the view that it is an adherent reticulum or network, and not a syncytium.

[4] Loeb, Leo. 1920 The movements of the amoebocytes and the experimental production of amoebocyte (cell-fibrin) tissue. Washington University Studies, vol. 8, Science Series no. 1.

Resumen por el autor, Sidney M. Cone.

Terminaciones de los nervios seccioa ados.

El presente trabajo comienza con una referencia al trabajo experimental de Cajal sobre la regeneración de los extremos de los nervios. El autor describe sus observaciones en el caso de nervios lesionados en heridas de guerra, en los cuales los corpúsculos de Pacini se formaron en el tejido subcutáneo de un muñón doloroso en un dedo amputado. Estos cuerpos han podido seguirse en su orígen hasta un fascículo de nervios del callo nervioso vecino. El autor describe el corpúsculo de Pacini y su formación. También incluye una referencia al método de teñido.

Translation by José F. Nonidez
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ENDINGS OF CUT NERVES

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ONE PLATE (FOUR FIGURES)

Cajal's recent article in the July number of the Siglo Medico, Madrid, describing the regeneration of nerve ends in experiments on animals, reports inability to obtain regeneration of end bodies of sensory nerves. The wild growth of embryonal nerves is noted, but he has not been able to demonstrate specialized end organs.

Among the many peculiar manifestations of new nerve growth following war injuries, in my collection, is one of pacinian bodies (Vater's corpuscles) in a finger stump. The ring-finger had been amputated, and a year later the stump was again removed on account of pain. The note made by me at the time of the microscopic examination calls attention to nerve callus following the nerve trunk and spreading in the subcutaneous tissue and scar. Numerous pacinian bodies were noted. The nerve callus does not differ from that which I found in all cases of war-injured nerves. The individual fasciculi, consisting of ten to twenty nerve fibers measuring 2 to 4 μ each, intertwine about the original nerve, passing beyond it to the loose subcutaneous tissue and into the stump scar. A few fasciculi break up into individual fibers at the formation of large, oval, lamellated bodies, varying in size from 60 to 150 μ long and 40 to 60 μ wide. Several capillaries of the fasciculus pass with the individual nerve fibers into the pacinian corpuscle and spread at the periphery. The nuclei of the Schwann sheath cells become even more than ordinarily elongated and flattened at the circumference, but three or four entire cells are demonstrated in the central core. The fasciculi, as they end at these bodies, are made up of elongated nuclei and varicose fibers (Peroncito's spirals). The

capillary vessels within the fasciculus pass into the body and also course round about the corpuscle. The nuclei are numerous and compressed between the flattened fibers. Indeed, one cannot tell the difference between the nucleus and axis-cylinder in these bodies any more than was it possible to distinguish nucleus and nerve in the embryonal fiber in nerve callus. The periphery of the body is made of thinner, more compressed layers than the center. A capsule of vascular connective tissue encapsulates the Vater corpuscle. In the center the Schwann sheath cell nuclei are swollen and well stained. There is no adult connective tissue in the bodies. The entire process looks like a swelling and rounding off of the new nerve callus tips in subcutaneous fat. These specimens were stained with the neurokeratin stain, described by me in the British Journal of Surgery, May, 1918.

I am greatly indebted to Prof. Hugh R. Spencer for the photographs.

PLATE 1

EXPLANATION OF FIGURES

1 Nerve callus about the cut digital nerve.
2 Fasciculus of nerve callus passing into the pacinian corpuscle.
3 Three pacinian bodies in subcutaneous fat.
4 Individual pacinian (Vater) corpuscle demonstrating stratified layers, capillaries and Schwann sheath cell nuclei.

A
B
C
D

Resumen por el autor, A. L. Salazar.

Sobre la existencia de falsos cuerpos amarillos autónomos en la glándula intersticial de la coneja.

El autor llama la atención acerca de la existencia, en el ovario del conejo (ovario de tipo intersticial), de cuerpos amarillos atréticos, con una evolución autónoma; estos cuerpos atréticos a diferencia de los ordinarios, no se amalgaman en la glándula intersticial, sino que pasan autonómicamente a través de su evolución propia, aislados dentro de una cápsula de tejido conectivo. El autor describe brevemente las características de los cuerpos atréticos autónomos, y admite la posibilidad de su confusión con viejos cuerpos amarillos genuinos, siendo probablemente esta confusión una de las causas de las opiniones contradictorias formuladas en relación con la regresión de los cuerpos amarillos verdaderos.

Translation by José F. Nonidez
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SUR L'EXISTENCE DE FAUX CORPS JAUNES AUTONOMES DANS LA GLANDE INTERSTITIELLE DE LA LAPINE

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ONE FIGURE

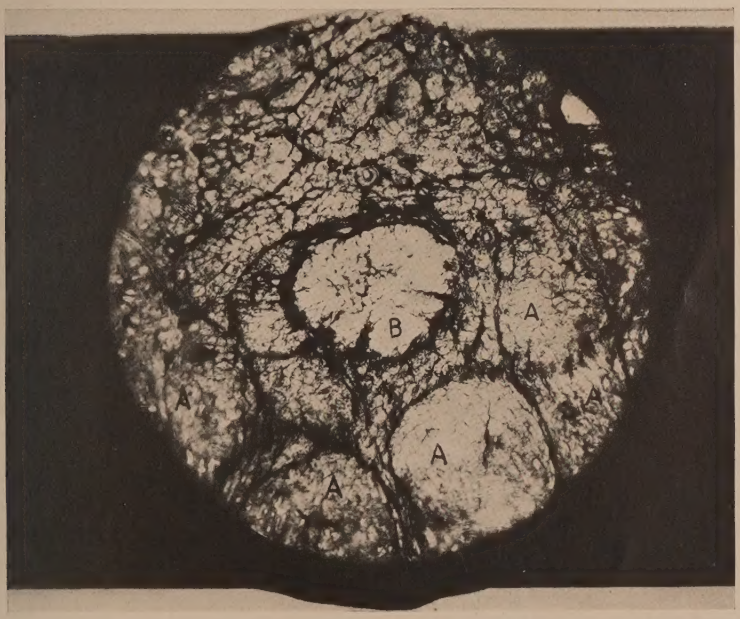
Limon, dans son travail[1] sur la glande interstitielle, dit que chez la Lapine "à la longue le faux corps jaune perd son individualité. Lorsqu'il ne reste plus de trace de la membrane de Slavjanski, il perd sa disposition arrondie. Il s'étire, s'aplatit transversamment." Cette description n'est pas absolument exacte; car, si quelques corps jaunes atrétiques s'aplatissent, s'étirent, au moment de leur fusionnement, d'autres conservent leur aspect arrondi; cela dépend des dimensions du follicule originaire, de leur position et d'autres circonstances, dont nous occuperons plus tard à propos de la formation du faux corps jaune. Ce que nous voulons signaler ici est que si la plupart des corps jaunes atrétiques perdent leur individualité et se fusionnent, quelques-uns conservent leur individualité pendant leur cycle, sans jamais se fusionner dans la nappe interstitielle. Nous les appellerons 'faux corps jaunes autonomes' pour les différencier de ceux qui se fusionnent dans la nappe interstitielle. Dans les coupes au tannin-fer les faux corps jaunes autonomes se reconnaissent facilement, même à de petits grossissements, grâce aux caractères suivants. Dès le moment de leur formation par atrésie folliculaire et hypertrophie de la thèque, ils s'entourent d'une épaisse coque conjonctive plus puissante que celle des faux corps jaunes habituels. Cette coque conjonctive accompagne le corps jaune atrétique autonome jusqu'au moment de sa

[1] Limon, Étude histologique et histogénique de la glande interstitielle de l'ovaire. Arch. Anat. Micr., T. 5, 1902.

disparition, tandis que la coque conjonctive des autres faux corps jaunes disparaît en partie au moment de leur fusion. Un autre caractère important des corps jaunes atrétiques autonomes est que la métamorphose adipeuse de leurs cellules débute dans le centre et de là irradie vers la périphérie. Il arrive un moment où toutes les cellules du faux corps jaune autonome se trouvent chargées de grosses boules lipoïdes. On voit alors le faux corps jaune autonome envahi par un tissu conjonctif puissant; cette invasion est due à l'effet convergent d'un envahissement conjonctif exogène et d'une prolifération endogène. Le conjonctif exogène vient de la coque conjonctive, accompagné de vaisseaux, qui en général se disposent en couronne dans la périphérie du corps jaune atrétique; le conjonctif endogène provient de la prolifération de la cicatrice conjonctive du follicule atrésié. De cette invasion conjonctive conjuguée avec la prolifération endogène il résulte la transformation du faux corps jaune dans un nodule cicatriciel. Cette transformation se fait grâce à un processus spécial, où le rôle actif appartient au conjonctif. En effet, on voit les fibres conjonctives énucléer les grosses boules lipoïdes qui font hernie dans les cellules. Les boules lipoïdes tombent ainsi dans le conjonctif qu'on trouve entièrement chargé de sphères lipoïdes. Certaines fibrilles conjonctives semblent être formées par les cellules interstitielles; ces faits sont à rapprocher de ceux que Mulon[2] a décrits dans le vrai corps jaune. Nous ne pouvons entrer ici dans les détails sur ce processus énucléateur. Les cellules présentent, dans leur évolution au dedans du faux corps jaune autonome, les mêmes caractéristiques générales que dans la nappe interstitielle: la lipogenèse s'y fait aux dépens du chondriome tannophile de la même manière. On y voit aussi de nombreux cristalloïdes. Il y a même des faux corps jaunes autonomes où prédomine la graisse, d'autres où prédominent les cristalloïdes. D'autres, enfin, sont caractérisés par la présence dans presque toutes les cellules d'un système de canalicules et lacunes étoilées. Nous ne savons rien sur la signification de ces différences; elles peuvent représenter diffé-

[2] Mulon, Sur un corps jaune kystique formé au dépens d'un ovisac non déhiscé. Arch. Anat. Micr., T. 11, 909, 910.

rentes étapes d'une même évolution cellulaire, ou des modalités structurales et fonctionales diverses. Nous n'avons pu non plus, jusqu'ici, observer nettement la destinée finale des cellules des faux corps jaunes autonomes; les faits observés par nous à ce propos sont assez contradictoires. Au moment de l'énucléa-



Ovaire de Lapine du type interstitiel cloisonné. *A*, *A*, *A*, corps jaunes atrétiques habituels; *B*, corps jaune atrétique à évolution autonome. Fixation, liquide de Bouin; méthode tanno-ferrique.

tion conjonctive des boules lipoïdes on voit entre les fibres collagènes des lambeaux déchirés de protoplasme interstitiel avec son aspect réticulé caractéristique; parfois on voit ici et là, dans les vieux corps jaunes autonomes des îlots de petites cellules polyèdriques très pauvres en protoplasme, ce qui semble indiquer que les cellules, après l'énucléation des boules lipoïdes, rentrent au repos. Mais ces faits ne possèdent pas la généralisation suffisante pour établir nettement la question. Les faux corps

jaunes autonomes sont habituellement ronds, les périphériques sont piriformes; après la prolifération conjonctive ces derniers semblent suspendus de l'albuginée par un puissant pédicule conjonctif. Nous avons observé un cas où ce pédicule était parcouru par un cordon épithélial qui naissait dans l'épithélium germinatif sous la forme d'une invagination, qui ensuite se transformait dans un cordon et pénétrait ainsi dans le pédicule conjonctif, où il se perdait. Certains corps jaunes atrétiques autonomes possédent une coque conjonctive incomplète, en forme de croissant.

Il est bien possible qu'on ait confondu jusqu'ici les faux corps jaune autonomes avec les reliquats des vrais corps jaunes. Cette confusion peut êxpliquer jusqu'à un certain point les opinions si contradictoires qu'on a émises à ce propos. Nous ne pouvons cependant être affirmatifs à ce propos, car, presque toujours les travaux sont très pauvres en documents iconographiques sur les reliquats des vrais corps jaunes. Cependant, quand on étudie la littérature, on voit que les auteurs se partagent, à propos de la destinée du vrai corps jaune, en deux catégories absolument irréductibles. Pour les uns, les vrais corps jaunes participent dans la formation de la glande interstitielle, totalement,[3] ou partiellement,[4] pour les autres il subit une régression adipeuse et fibreuse. Or, les auteurs de la deuxième catégorie décrivent la régression de vrai corps jaune de telle manière, que leur description pourrait s'appliquer presque entièrement à l'évolution du corps jaune atrétique autonome. Ont-ils décrit, non des reliquats du vrai corps jaune, mais de vieux corps jaunes atrétiques autonomes? Nous l'ignorons, mais cela est probable. Cependant, on peut admettre une autre hypothèse, à savoir, qu'à partir d'un certain moment, le vrai corps jaune et le corps atrétique autonome présentent des caractères communs; seule, alors une étude minutieuse permettra de chercher les caractères différentiels. Conclusion: l'existence de corps jaunes atrétiques autonomes nous oblige à reprendre le problème, si obscur encore, de la destinée du vrai corps jaune.

[3] Pflüger et V. Ebner.
[4] V. der Stricht, etc.

Les faux corps jaunes autonomes n'existent pas dans tous les types d'ovaire; ils se montrent dans les ovaires du type interstitiel.[5] Mais tous les ovaires de ce type ne présentent pas des corps atrétiques autonomes en nombre égal. Certains ovaires à type interstitiel non cloisonné,[6] très volumineux, ayant dans la nappe interstitielle des champs de cellules interstitielles à type lutéinique, présentent de rares corps autonomes ou n'en presentent aucun; d'autres ovaires du type interstitiel cloisonnê présentent de nombreux corps atrétiques autonomes. Ils semblent, donc, caractériser un moment donné de l'évolution de l'ovaire; mais cette question exige de plus amples recherches.

Jusqu'ici nous n'avons pas trouvé des différences cytologiques entre les cellules qui évoluent dans la nappe interstitielle diffuse et celles qui sont logées dans les corps atrétiques autonomes: chondriome tannophile, lipogénèse, crïstallogénèse, système de lacunes et canalicules et d'autres caractères cytologiques de la cellule interstitielle se trouvent indifféremment dans les cellules de la nappe diffuse et dans celles des corps atrétiques autonomes. Cependant, nous n'avons pas pu faire encore un examen assez approfondi de ces deux types de cellules; il est probable que cette similitude ne soit qu'apparente et due à une connaissance superficielle des deux types cellulaires.

[5] Sobotta, Regaud, Popoff, etc.

[6] Pour cette nomenclature voir la note "Sur l'évolution de l'ovaire adulte de la Lapine." Compt. Rend. de la Soc. de Biol. No. 30, T. 85.